Faculty Working Papers

REVEALED BUREAUCRATIC PREFERENCE AND PRIORITIES
OF THE CONSUMER PRODUCT SAFETY COMMISSION

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of Economics

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Summary:

In June of 1977, the U.S. Consumer Product Safety Commission announced priorities for those projects to be executed during the next fiscal years. This study of these priorities adapts conditional logit techniques for analysis of random orderings and estimates parameters of CPSC preference functions among projects. The CPSC is shown to overselect projects with large safety benefits, but even larger consumer costs, and projects which lead to mandatory standards.

By authority of the five acts it administers, the Consumer Product Safety Commission (CPSC) is empowered to reduce or eliminate consumer exposure to unreasonable hazards from literally thousands of household related products. Yet this vast task is to be accomplished with a budgetary allotment from Congress which the Commission has on several occasions stated to be inadequate for proper execution of its mandate. In light of these considerations, it would seem vital for the CPSC to organize the myriad of potential regulatory projects into a coherent set of priorities. Yet not until FY1977 did the Commission publish explicit priorities for those projects to be potentially executed. The significance of these priorities is twofold. First, since several of the projects considered for execution involved economic impacts on the order of hundreds of millions of dollars each year, CPSC priorities represent an important resource allocation question in and of themselves. But secondly, it is the basic argument of this essay that CPSC selection of priorities systematically revealed the underlying preferences of the agency as regards the political and economic aspects of regulation.

I. The Development of CPSC Priorities

During the first years of its existence (1973-1976), the CPSC selected regulatory activities in an informal process that was ill-defined, and in retrospect, ill-advised. Potential projects were identified on the basis of two sources of information: hospital emergency-room data collected by the internal National Electronic Injury Surveillance System (NEISS) and petitions submitted under section 10 of the Consumer Product Safety Act (CPSA). Initially, the Commissioners planned to use only the emergency-room data for targeting useful regulatory actions. More specifically, the Commission voted to process NEISS data into a Hazard Index (see Table One) and to generate and execute first those projects which ranked highly in this Index.[2] In other words, a ranking of consumer products based on the Hazard Index was to serve as the priority list for the Commission.[3]

Use of this Hazard Index as a basis for priorities is subject to several immediate and telling criticisms. While an extended discussion of the Index can be found elsewhere,[4] the most basic problems are due to the use of association rather than causality as the basis for inclusion of accidents (hence floors, tables, and chairs rank high on the basis of the Index because they are frequently associated with household injuries); due to the failure to correct for product usage (hence truly dangerous products with limited sales will rank low in terms of the Index); due to ommission of amenability of the hazard to regulatory reduction as a factor in ranking (hence knives and matches rank high on the Index); and due to the reliance on emergency room data which understates deaths and ignores property damage (hence fire related accidents rank excessively low by the Index).

The fundamental difficulty with the Index is quite probably that it does not embody a defensible definition of "unreasonable risk of injury." Yet inasmuch as Congress has explicitly mandated the CPSC to prevent unreasonable risks, such a definition would seem required. A plausible approach to the identification of unreasonable risks would appear to focus on those hazards which are not foreseen or are not easily managed by most consumers, and which at the same time can be readily prevented through collective action. In contrast, the CPSC apparently originally regarded hazards as unreasonable simply because they occurred with high frequency and severity. An unfortunate side effect of this (mis-) definition of "unreasonable hazard" was that very little room for economic considerations remained during early selection of CPSC projects. Accordingly almost no benefit-cost estimates for regulatory activities were generated <u>before</u> agency commitment to projects. Instead, economic impact statements were prepared after projects were well advanced, in a fashion and with consequences similar to environmental impact statements. For these initial projects, it is thus virtually inconceivable that CPSC choices could represent reasonable targeting of regulatory effort on economic grounds. Even more egregiously, <u>no</u> estimates of agency resources utilized for each project were prepared during these early years. Thus even while the Commission publicly argued that it suffered a severe budget constraint, no efforts were (or could be) made to efficiently allocate agency resources among various projects, because the requirements of each project were unknown.

The second origin of potential regulatory projects were petitions to the CPSC by outside interests which formally requested specific regulatory action against a specific consumer product hazard. During calendar year 1973-1974, the Commission granted 9 of the 14 petitions seeking mandatory standards or products bans; an additional three petitions were granted in 1975. While an analysis and critique of the petition process can be found elsewhere, early CPSC enthusiasm for "public participation" in the regulatory process enabled outside interests to substantially influence the agency's commitment of resources to projects.[5]

Under pressure from Congress (notably Senator Proxmire), the Commission began in late 1976 to develop a more explicit and defensible set of procedures. The CPSC had initially devoted the bulk of regulatory effort to promulgation of mandatory safety standards for specific products. Unfortunately, due to the fact that such standards apparently require two to five years of development time, the Commission was notably short of definite accomplishments by 1976, the third year of its effective existence. In light of this supposedly poor track record, the CPSC found it increasingly necessary to justify its distribution of expenditures and regulatory effort among potential projects. Enter priorities.

The systematization and rationalization of project selection was speeded when in May, 1976 Ford-appointee John Byington assumed office as Chairman of the CPSC. Empowered by the 1976 Amendments to the Consumer Product Safety Act to directly administer CPSC staff, Byington devoted additional resources to the issue of Commission priorities and by July 1, the Commission announced in the Federal Register plans to establish priorities for potential projects on the basis of the following criteria:

1) frequency of accident
2) severity of accident
3) amenability of accident to regulatory prevention
4) chronic nature of risk
5) benefit-cost ratio
6) unforeseen nature of risk
7) probability of exposure to risk
8) vulnerability of population to risk
9) agency resource usage.

Amenability was later dropped from the list of criteria on the grounds that it was already implicitly included in the benefit-cost ratio. (The fact that most all of the remaining criteria are also implicitly included in the benefit-cost ratio does not seem to have occurred to the Commission. More on this point later.)

The Commission directed the staff to collect the necessary data and develop a preliminary ranking of projects. This direction led to an almost nine month process of data accumulation and analysis. First, projects to which the agency was partially committed were identified, an effort which isolated over 180 projects for which some CPSC funding was in 1976 being expended. The magnitude of this number was not expected, particularly since the CPSC had resources to effectively execute only 10-20 projects in a given year. Secondly, most all available statistics on the published criteria (except for staff resource demands, on which there was no data) for 35 key projects were gathered into publications called Product Profiles and publicly released in October, 1976. The goal of this data disclosure was to promote public discussion and interaction for the priorities exercise. In November of 1976, the staff narrowed the 180 potential projects down to 52 candidates for ranking. For these 52 projects (which included most of the 35 treated in the Product Profiles) additional data was collected as necessary. In particular, estimates of total agency resources needed for completion of each project were generated. Further, most projects were rated on a high-medium-low basis as to fulfillment of each of the published criteria. For example, projects with over 10,500 injuries a year were rated as high in frequency of accident, or projects with mean severity of less than 17 (based on the exponentially increasing severity scale discussed earlier) were rated low as regards that criteria. For only 38 of the candidate projects was there sufficient data to generate a full set of the appropriate ratings. In any case, all available data on each of the 52 projects were gathered into a volume labeled the Mid-Year Review (MYR) and published in March of 1977. Alongside this data, the MYR contained information on procedural background for each project, as well as extensive discussions of the comparative merits and defects of various projects. Between March and May, the five Commissioners were repeatedly briefed on contents of the MYR. Several projects were added as priority candidates by direction of the Commission. Then, by consensus decision, the Commissioners divided all projects under consideration into those to be executed in 1977-1978 (high priority; 29 projects), those to be executed in 1978-1979 (medium priority; 17 projects), and those whose execution would be delayed for the near future. There were fewer projects in the medium than the high priority category due to the fact that most projects in the latter category would extend beyond the initial 1977-1978 period. Finally, on June 1, each Commissioner ranked in numerical order all projects within both the high and medium categories. The individual rankings by the five Commissioners were than aggregated by Borda rule into rankings for the Commission as a whole. The resulting priority list is given in Table Two.

This study is devoted to an examination of how various attributes of the considered projects affected their relative rankings in the final priority list. Among the considerations raised by this examination is the extent to which the CPSC acted in accordance with the published procedures announced July 1, 1976 or rather to what extent unannounced factors played an important role. The samples for the study are as follows. For 38 projects, data can be tabulated for the staff-developed high-medium-low ratings of the announced criteria, as mentioned above, and these projects compose the first sample. Additionally, for a 26-project subset of the 38 projects above, it is possible to tabulate specific estimates of the monetary benefits and costs to consumers of CPSC actions (again from the MYR and the Product Profiles). These 26 projects constitute the second sample.

Details of data used for this study, including comments on its shortcomings are included in Section Three of this essay. In the next section, the statistical procedure used to analyze this data is outlined.

II. Basic Aspects of Random Orderings

While the announced ranking of projects is expectedly related to the various observable project attributes, it is unlikely that this relation will be exact, or deterministic. The priorities of the CPSC thus represent a random ordering based on observable project attributes. This ordering is devoid of any implications of cardinality, being based simply on comparisons of ordinal or relative importance of projects. In other words, the ranking numbers (as well as the high or medium categories) in Table Two have no statistical significance in and of themselves, serving merely to indicate the relationships of relative importance among the various projects. Statistical technique appropriate to ordinal dependent variables then must be used for analysis of CPSC priorities. At this point, a minor problem emerges--available ordinal techniques are limited to probabilistic selections of single projects out of project sets, and do not currently provide for probabilistic rankings or orderings. And while the relationships between selections and rankings are quite straightforward in the deterministic case, the introduction of stochastic elements makes these relationships more complex. Nonetheless, there are several basic principles connecting random choices and orderings, as outlined below.[6]

The CPSC will be regarded as selecting projects for execution on the basis of a usefulness index (or utility function) which is a linear combination of functions of observable project attributes:[7]

(1) $\quad U(x_j) = b^t x_j + e_j$ for all j in A

where x_j = vector of functions of observable attributes

b = vector of policy weights for elements of x_j

e_j = scalar contribution of unobservable attributes

A = set of (n) projects

The CPSC is thus regarded as choosing for execution the projects in A with the largest usefulness indices (or utility), where these indices are based on observable attributes. When the unobservable terms (e_j) are randomly distributed over the projects, the choice of a particular project will not occur with unitary probability. Rather the probability that a specific project (j) will be selected, denoted S(j;A), may be expressed in terms of the usefulness indices as:

(2) $$PrS(j;A) = Pr(U(x_j) > U(x_k) \text{ for all } k \text{ in } A)$$

As mentioned above, there is a substantial literature which provides for estimation of the policy weights (b) based on probabilistic selection as in (2).[8]

This study, however, concerns probabilistic rankings and not probabilistic selections. Using the usefulness functions in (1), the probability of a given project ranking being chosen out of the set of (n!) possible rankings may be written as:

(3) $$Pr(r) = Pr(U(w_1) > U(w_2) > U(w_3) > \ldots > U(w_n))$$

where r = exhaustive ranking of project set A

r_j = rank order position of j in A within the particular ranking r

w_k = vector of functions of observable attributes for the project with rank order k; it should be noted that $w_{r_j} = x_j$.[9]

Almost no empirical work has been performed using random orderings as in (3), so that at first examination, no simple estimation programs exist for analysis of these orderings. Fortunately, however, in the special case when the error terms in (1) have independent, identical extreme value distributions, then the probability for a given exhaustive ranking as in (3) may be expressed as a product of selection probabilities from (2).[10] Thus existing technique for analysis of selection probabilities may be used after all. More specifically, the extreme value distribution is:

$$(4) \qquad \Pr(e_j < v) = \exp(-\exp(-v))$$

When the error terms in (1) are independently, identically distributed as in (4), the selection probabilities in (3) may be written as:[11]

$$(5) \qquad \Pr S(j;A) = \frac{\exp(b^t x_j)}{\sum_{k \varepsilon A} \exp(b^t x_k)}$$

Further, using (4) the probability of the ranking in (3) may be expressed in terms of these selection probabilities as:[12]

$$(6) \qquad \Pr(r) = \Pr S(r_1;r_1,r_2,r_3,\ldots r_n) * \Pr S(r_2;r_2,r_3,\ldots r_n)$$

$$*\Pr S(r_3;r_3,r_4,\ldots r_n)$$

$$* \ldots *\Pr S(r_{n-1};r_{n-1},r_n)$$

It should be recognized that (6) is in general not correct and in fact occurs only under the circumstances that (4) holds.

If the CPSC priorities described in Section I were indeed an exhaustive ranking of projects considered, then (6) would represent the likelihood function for this study, and maximization of (6) would yield the desired estimates of policy weights. In actuality, as discussed earlier, the priority decision process used by the CPSC was slightly more complex. First, projects were segregated into three categories (high, medium, and low); secondly, those projects in the high and medium categories were exhaustively ranked. The first step may be regarded as generation of a categorical ranking, the probability of which may be expressed as:

$$(7) \qquad \Pr(r;c_1,c_2,c_3) = \Pr(U(w_{1/1}),U(w_{1/2}),\ldots U(w_{1/c_1}) > U(w_{2/1}),U(w_{2/1}),\ldots U(w_{2/c_2}) > U(w_{3/1}),U(w_{3/2}),\ldots U(w_{3/c_3})$$

where c_j = number of projects in category j

$w_{j/k}$ = project number (k) in category (j)

Thus the likelihood function for the CPSC priorities actually should consist of the product of the probability of the categorical ranking of all projects (with three categories) and of the probabilities of two exhaustive rankings with only those projects in each of the first two categories. Unfortunately, the probability in (7) does not decompose into products of selection probabilities, and this second approach thus requires nonlinear estimation based on a very complex likelihood function.

A more promising strategy is to treat the CPSC priorities as a <u>partial ranking</u>, or a ranking of only the first (p) out of (n) projects in A. A partial ranking may also be defined as a categorical ranking where the first (p) categories contain but one project each. Based on the usefulness indices in (1), the probability of a partial ranking is clearly:

$$\text{(8)} \qquad \Pr(r;p,n) = \Pr(U(w_1) > U(w_2) > U(w_3) > \ldots > U(w_p) > \max(U(w_{p+1}) \ldots U(w_n)))$$

In fashion similar to an exhaustive ranking and dissimilar to a categorical ranking, a partial ranking may be expressed in terms of selection probabilities when the error term for the usefulness indices are independently, identically distributed as in (4):

$$\text{(9)} \qquad \Pr(r;p,n) = \Pr S(r_1;r_1,r_2,\ldots r_n) * \Pr S(r_2;r_2,r_3,\ldots r_n) * \ldots * \Pr S(r_p;r_p,r_{p+1},\ldots r_n)$$

By regarding the announced CPSC priorities as a partial ranking of a fixed project set, the likelihood function for this study is thus the product of selection probabilities as in (9). Using the numerical expressions for these selection probabilities in (5), the log-likelihood function for these priorities becomes:

$$\text{(10)} \qquad L(b,x) = \log(\Pr(r;p,n)) = \sum_{j=1}^{p} \log \frac{\exp(b^t x_j)}{\sum_{j=1}^{p} \exp(b^t x_i)}$$

Maximization of (10) yields the estimates for policy weights in the utility function (1) above.

III. Data

All data for this study are drawn from CPSC documents, notably the Mid-Year Review (MYR) and the earlier Product Profiles. In all cases, data were chosen from the more recent MYR if at all possible. An outline of data for this study, and discussions of their deficiencies follows, while the most significant variables from the 26-project sample are listed in Table Three.

A. Announced Criteria

As part of the MYR, and as preparation for the priority-setting exercise, the CPSC staff prepared ratings for each project for almost all the criteria continued in the July 1, 1977 Federal Register announcement. These ratings expectedly established the extent to which each project embodied the criteria in question, and segregated each project into high, medium, or low categories based on each criterion. Specific criteria for which ratings were prepared were:

frequency of injury (FI)

severity of injury (SI)

unforeseen nature of risk (UNR)

probability of exposure (PEXP)

vulnerability of population (VP)

risk of chronic hazard (RCH)

benefit-cost ratio (RBC)

For this study, each of these variables was given value (2) if in the MYR the criterion had been given a "high" rating; variables with "medium" ratings were given values (1) and "low" ratings value (0). Several other specifications with these variables were tried, all with virtually identical results.

B. Consumer Benefits and Costs

Procedures used here for calculations of benefit-cost data are identical to those used by the CPSC staff in preparation for the MYR. Benefits are measured as simply the product of total accident costs associated with a particular product in 1976 multiplied by the expected percentage reduction in these costs which would occur when and if the proposed project becomes fully effective. Estimated deaths are calculated as 139% of reported deaths, to correct for underreporting (not all states participated in CPSC data collection efforts). Injury costs are computed using procedures developed by Technology and Economics, Inc. under contract from the CPSC. The separate cost components that together constitute the total injury cost are: health insurance costs, product liability insurance, litigation costs, foregone earnings, pain and suffering, retreatment, disfigurement, transportation and visitor's costs, and hospital (including physician) costs. Offsetting these benefits of reductions in accident costs are the concommitant increases in regulatory costs, mostly derived from price increases to consumers and from agency expenditures or resources. Increased costs to consumers are calculated as simply the product of retail sales for a particular product in 1976 multiplied by the expected percentage increase in price due to CPSC action. By inspection, these benefit and cost estimates will be exact proxies for actual project benefits and costs only if a) projects are instantly fully effective and b) product demand is completely inelastic. The data are further limited in that cost estimates do not account for valuation of reductions in product utility which safety attachments and related product reformulations so often cause.

C. Hazard Index

While the MYR contained explicit values for number of injuries and deaths, as well as calculated mean severity, values for the CPSC Hazard Index were not available for most projects. Consequently, the hazard index variable used in this study is the simple product of frequency and mean severity <u>without</u> adjustment to more heavily weight childrens' accidents (HAZ). Correlation of the computed hazard index for this study, and the CPSC Index is quite high for those few projects where comparison can be made, so little bias is introduced through this tactic.

D. Ethical Variables

Based on staff discussions in the <u>MYR</u> as to the extent to which specific subgroups of consumers were particularly vulnerable to hazards reduced by each project, two zero-one variables were created, representing whether or not either children or the elderly were particularly susceptible to these hazards (VPC and VPE). Additionally, the ratio of consumer death costs to total accident costs (injury plus death costs) was computed for each project (DCR).

E. Regulatory Strategy

In order to determine the expected consumer benefit and costs for each project, the CPSC staff necessarily determined the "most likely" strategy for regulation of those hazards considered. Strategy options were: mandatory standards (requiring by law removal or redesign of product), voluntary standards (industry self-design and self-adoption of safety standards), information and educational campaigns (with no alteration of products), and childproof packaging requirements. Four zero-one variables were prepared representing whether or not each project involved each of the above mutually exclusive regulatory strategies (MS, VS, IE, PACK).

F. Regulatory Effort Variables

Given the most likely regulatory strategy, the CPSC Associate Executive Directors prepared estimates of the professional person-months likely to be utilized by each project in FY1977 (E77) and FY1978 (E78) along with the percentage of total professional person-months necessary for project completion which would have been expended by the end of FY1978, assuming an "average" pace for project completion (PC78). Finally, very early estimates of administrative cost alone were recovered from a 1976 CPSC memoranda (AC). These earlier figures should be regarded even more cautiously than data collected from the MYR.

IV. Empirical Findings

Estimation results are presented in Tables Four through Eight. Results in the first five of these tables are based on the 26-project sample for which specific estimates of costs and benefits can be obtained, whereas results in Table Eight are taken from the 38-project sample. Several different specifications of utility functions are offered, with results that are strongly similar across all equations. Coefficient estimates are for the vector of policy weights in equation (1), (8), (9), and (10) of Section II. Variance terms for the coefficient estimates are taken from the diagonal of the estimated variance-covariance matrix based on the log-likelihood function in (10), or:

$$(11) \qquad V = \left[-\mathrm{Exp} \frac{\partial^2 L(b,x)}{\partial bb^t} \right]^{-1}$$

where this matrix of derivatives is evaluated with actual project attribute values and with estimated policy weights. The ratio of a coefficient estimate and the associated standard error are reported as C/SE Ratio throughout the tables. Reported goodness of fit measures are the Spearman Rank Correlation coefficient between the announced and predicted rank (SPR), and the standard likelihood ratio (LR).[13]

The estimates offered in Tables Four through Eight represent specifications of agency utility functions. If a value of (ordinal) utility is fixed, then the estimated equations in these Tables trace out indifference curves for revealed agency preferences. The indifference curves, and in particular the slopes along these curves (the marginal rates of substitution) are generally regarded as the most important information conveyed by the utility function.

In a probabilistic sense, the absolute magnitudes of the estimated policy weights are also interpretable. The estimated probabilities of selection for individual projects out of project sets may now be computed using (5), and the probabilities of particular partial rankings may be computed using (9). An interesting interpretation of the absolute magnitude of coefficients in the accompanying Tables is provided by consideration of the elasticity of the odds for selection of project versus another (or $\frac{PrS(j;A)}{PrS(k;A)}$) with respect to any project attribute, where (x_{ij}) is attribute (i) of project (j). This elasticity is simply $(b_i x_{ij})$.

The specifications in Table Four indicate that the primary determinants of agency rankings are the expected benefits and costs of various projects, along with the nature of regulatory response--namely mandatory standard or not. A first conclusion of the study is that projects which culminate in mandatory standards are given preferential rankings, while projects which lead to voluntary standards, informational campaigns, or childproof packaging are ranked much lower. The significant positive coefficient of the mandatory standards dummy variable indicates that the usefulness index for projects which lead to mandatory standards must be relatively large, thus these projects will be ranked highly. These conclusions carry over when benefit and cost figures are replaced by the ratio of these values, and also by the CPSC staff rating (high, medium, low) of the benefit-cost ratio which was presented in the MYR.

A second conclusion to be drawn from Table Four is that the CPSC tends to weight safety benefits more heavily than costs imposed on consumers. The first specification indicates that benefits are more heavily weighted by a factor of ten. The implied indifference curves are drawn in Figure One, with a marginal rate of substitution (MRS) of costs for benefits of one-tenth (0.1). In the third specification, benefits and costs nonlinearly enter the utility function. The MRS for indifference curves generated by the utility function declines continuously as project "size" increases, as indicated in Figure Two. Essentially, the MRS is higher for small projects which produce few benefits or costs, and lower for large projects. It is important to recognize that the third specification does not impose a diminishing MRS on the utility function. For if the estimated coefficients on LNB and LNC were equivalent, then the indifference curves would be a family of rays from the origin, all with constant MRS. If the coefficient on LNB were less than that on LNC, then increasing MRS is implied. As it is, the benefit coefficient is statistically significantly different from the cost coefficient in both the first and third specifications.[14]

The specifications in Table Two demonstrate that, contrary to the announced procedures for priorities, most all of the remaining published criteria were not influential in determining the final priorities.[15] Numerous specifications using more aggregate versions of these criteria were tried, with virtually identical results. If any of the additional criteria are at all significant, it would appear to be the frequency of accidents, representing a carryover from the Hazard Index. This variable, however, is not robust to changes in specification, and hence conclusions on the importance of this variable are suspect. Actually, it would appear that with one exception (discussed in the next paragraph) no criteria other than those mentioned above and presented in Table One were at all relevant in determination of CPSC rankings. However, a qualification should be emphasized here--none of the projects in the 26-project sample and only two in the 38-project sample exhibited any risk of chronic hazard. It is thus quite likely that the failure of this criteria to be a statistically significant determinant of Commission ranking is due more to peculiarities of data samples used in this study and less to actual Commission preference.

Specifications in Table Six introduce the Hazard Index, which is a significant determinant of CPSC decision, and various ethical variables, which are not.[16] The most statistically robust specification in Table Four (the third) is used as the basis for analysis. No significant differences in conclusions are made if other specifications in Table Four are used instead. The two vulnerability variables thus provide a second test of the null hypothesis that the announced "vulnerability" criterion was not used in Commission priority decision. Clearly, this hypothesis cannot be sensibly rejected.

In Table Seven, various measures of agency resources expended for project execution are added as possible components of CPSC utility functions. While all coefficients are of the expected sign, indicating conservation of resources and preference for rapid completion of projects, clearly the effects are exceptionally statistically weak. It is then impossible to reject the hypothesis that the CPSC completely ignored resources constraints and timeliness in project completion in its priority exercises (although in this context several remarks of the next section are of relevance).

Table Eight presents results for the larger (thirty-eight project) sample. While neither benefit-cost data nor the hazard index may be computed for several of the projects in this larger sample, the specifications that can be estimated provide confirmation of results for the 26-project sample.

Finally, the two subsections below provide consideration of corrections to CPSC benefit-cost data, as regards the failure to allow for discounting and as regards the failure to allow for nonzero elasticities of product demand. Neither correction influences the arguments of the text.

Discounting Corrections

The first problem with CPSC benefit-cost data (in the MYR and generally) is that issues of discounting are completely ignored. These issues arise due to the peculiar CPSC refusal to distinguish between product stocks and flows when preparing benefit-cost estimates. The CPSC computes project costs to consumers on the basis of product flow (a markup on retail sales), but calculates project benefits on the basis of product stock (a markdown on total injuries). For projects that are instantly fully effective, in the sense that the complete product stock is immediately replaced with newly-complying units, the CPSC procedure leads to no bias in estimates. For more durable products, however, any regulation induced changes in product design or manufacture will affect only a fraction of the existing product stock, and yield only a portion of the benefits of reduced injuries which CPSC estimates imply.

More specifically, if the yearly increase in consumer costs is constantly C, the eventual yearly reduction in accident risk costs is constantly B, product life is N in years, and the discount factor is d, then the correct specification of full costs and benefits for consumers are:

$$\text{Costs} = C \sum_{t=1}^{\infty} d^t$$

$$\text{Benefits} = \sum_{t=1}^{N} \left[\left(\frac{t\,B}{N}\right)d^t\right] + B \sum_{t=N+1}^{\infty} d^t$$

whereas the CPSC procedure regards project costs as simply (C) and project benefits as (B). If project costs are to be regarded as merely (C), then simplification of the benefit stream using summation by parts, and division of both consumer costs and benefits by $[d(1-d)^{-1}]$ to establish comparability yields:[17]

$$\text{Costs} = C$$

$$\text{Benefits} = \frac{1}{N}\left(\frac{1-d^N}{1-d}\right) B$$

Principal specifications from Tables Four and Six were reestimated using the deflated benefits measure derived above. Estimates of product life (N) for each project were taken from the MYR and the Product Profiles. Because the deflation factor for benefits depends nonlinearly on the discount factor, each specification was estimated five times using separate discount factors based on interest rates of 0, 1, 5, 10, and 50 percent. Two findings emerge. First, the basic arguments of this study are unchanged. Secondly, the value of the log likelihood function uniformly declines as discount factors based on higher interest rates are used. In other words, the maximum likelihood estimate of the interest rate implicitly used by the Commission in its decision is zero. This second finding suggests that the CPSC in its project selection is motivated less by true economic costs and benefits, than by the most politically salient aspects of potential projects.

Elasticity Corrections

A second correction may be made to CPSC estimates of costs and benefits to allow for regulation induced variations in product quantity demanded. A useful theoretical framework in which to make these corrections is outlined below.

The CPSC, in its estimates of consumer costs of regulation, practically and sensibly assumes that the industries to be regulated are reasonably competitive with roughly constant returns to scale in manufacture, or:

$$P = MC$$

$$MC = AC$$

where the variables above are respectively, price, marginal cost of output, and average cost of output. Thus average cost pricing, where any increase in manufacturing costs due to regulation are fully passed along to consumers in the form of higher prices is seen as a pragmatic approximation to actual industry practice.

Consumer demand, of course, depends not only on market price (p) but also on the risk cost of the product (r). The full price of the product to the consumer (p*) is then:

$$p^* = p + r$$

and quantity demanded of a hazardous product is a function of p* (as in Figure Three).[18] The benefits of CPSC regulation entail reductions of (r), while the regulatory costs to consumers lead to increases of (p). When project benefits exactly equal costs (ignoring agency costs), (p*) will be unchanged, thus quantity demanded will be unchanged. When benefits exceed costs, (p*) will fall, and quantity demanded of the product in question will increase (unless demand is completely inelastic). When project costs exceed benefits, the reverse movements in full price and quantity demanded occur.

The above arguments suggest that when the benefit-cost ratio of a project exceeds unity, the absolute (though not the relative) magnitudes of project benefits and costs will be understated. Graphically, current CPSC procedure, in the case of a decline in full price due to regulation, would ascribe net benefits of rectangle A in Figure Three to the project in question. Properly computed however (see the Appendix) net benefits are the summation of areas A and (triangle) B. Conversely, when the project benefit-cost ratio is unfortunately less than unity, both benefits and costs to consumers are overstated by CPSC methods. In Figure Four, actual net losses to consumers are trapazoid C, while the CPSC would exaggerate net costs to be the summation of area C and (triangle) D.

As a basis for correction of _MYR_ data, the following formulae for computation of net project benefits should be distinguished

$$\underline{MYR}: \qquad -\Delta p^* x_0$$

$$\text{proper:} \qquad -\Delta p^* x_0 - \frac{1}{2}\Delta p^* \Delta x$$

$$-\Delta p^* x_0 [1 - \frac{\eta}{2}(\%\Delta p^*)]$$

where (η) is the price elasticity of demand. The term in brackets thus represents a correction factor for net benefits, hence for absolute benefits and costs. Due to the fact that estimates of price elasticities of demand are not available for the detailed product categories represented by CPSC projects, an elasticity of unity was assumed for all products. Specifications in Tables Four and Six were thereby reestimated using the following revised estimates of project benefits and costs:

$$\text{Costs} = \quad C[1 - \frac{(\%\Delta p^*)}{2}]$$

$$\text{Benefits} = \quad B[1 - \frac{(\%\Delta p^*)}{2}]$$

where (B) and (C) are _MYR_ estimates, and where (B), (C), and ($\%\Delta p$) are different for each project. Because the basic arguments of the text are again supported, results of the reestimations are not reported.

V. Critique

The full process by which the CPSC reached its FY 1977 priorities reduced a complex decision into a series of three simpler decisions. First, for each potential project, determination was made for stringency of regulatory action, or the optimal severity of product redesign or consumer behavioral change which would be sought in order to improve safety. Secondly, given stringency, determination was made for the strategy of regulation, or the specific administrative procedure (mandatory standard, voluntary standard, informational campaign, etc.) which would be best employed to obtain the chosen epidemiological changes. Finally, from among the stringency-strategy pairs for products, priority was determined. While the project rankings which resulted from this three-step process may well not have been optimal primarily due to the fact that agency resource constraints would be ignored in determination of stringency), a plausible argument can be made that any potential improvement in social welfare is outweighted by the administrative costs necessary to simultaneously determine stringency, strategy and priority.[19]

Taking as given this procedural framework, optimal policy is straightforwardly defined.

Stringency — The accident rate should be lowered until the marginal benefit to consumers in terms of reduced risk cost equals the marginal cost to society of regulatory action, or

$$\frac{B_a}{C_a} = 1$$

where (a) represents the reduction in the accident rate and where $B_a > 0$, $B_{aa} \leq 0$, $C_a > 0$, $C_{aa} > 0$ (see Figures Five and Six).

<u>Strategy</u> Given appropriate stringency of response for a particular product, net social benefits from each possible regulatory strategy should be computed:

$$NSB = B - C - A$$

or net benefits to consumers minus costs to the CPSC of mounting and enforcing the strategy in question (A). The strategy with the largest net social benefits should be selected.

<u>Priority</u> For each project, the ratio of net benefits for consumers to CPSC administrative costs should be computed:

$$(B - C)/A$$

Projects should be ranked in terms of these ratios, and executed in order of that ranking until available agency resources for the given fiscal years are exhausted.[20]

The approach to safety regulation implied by estimated CPSC utility functions is dramatically different from optimal policy.

<u>Stringency</u> For any given utility function, the CPSC will reduce the accident level until:

$$\frac{B'}{C'} = MRS_{CB}$$

where the latter term is the marginal rate of substitution between consumer costs and benefits.[20] As observed earlier, a linear specification of CPSC preferences suggests an estimate of MRS_{BC} of one-tenth. Nonlinear specifications of agency utility suggest that for MRS_{CB} will be higher and for large projects, lower. In sum, these results imply that the CPSC pursues excessive stringency in its projects, which may more directly be seen by the fact that the majority of projects listed in Table Three exhibit benefit-cost ratios of less than one, hence ratios of marginal benefits to marginal costs of certainty less than unity.

Strategy

The CPSC will select project strategies which maximize agency utility, and not net social benefits. Three aspects of estimated agency preference function suggest that the CPSC overselects mandatory standards as safety procedures: a) the direct preference for mandatory standards, b) the excessive preference for project benefits over project costs, which leads to projects so stringent as to be achievable only by mandatory standards, and c) the inadequate influence of agency resource constraints.

The priority decision of the CPSC have been discussed at length earlier and need not be reconsidered at this point. As a general comment, it is difficult to defend most aspects of the complete CPSC regulatory strategy. There is little reason for regarding projects benefits as more socially significant than project costs. These benefits are reasonably computed, or at least the limited problem with existing calculations in no way justify heavier weighting of benefits than costs--most surely not at the levels implied by CPSC regulatory decisions. The pure preference for mandatory standards is particularly regretable. The CPSC, in the MYR and elsewhere, explicitly adjusts estimation of benefits and costs to take account of varying degrees of compliance with voluntary standards, and varying consumer responses to information campaigns. CPSC preferences thus effectively embody the attitude that lives saved and injuries prevented under mandatory standards are more important for public policy than those affected by other regulatory strategy. Finally, the failure of the CPSC to exhibit tendencies to economize on its allegedly scarce resources is hardly conducive to effective safety policy.

At least one aspect of the FY1977 priority decision, however, should be commended, namely the failure of the five commissioners to be bound by the announced guidelines. Most of the criteria in these guidelines have little direct relevance for policy decisions on consumer product safety. Of course, all of the criteria are indirectly reflected in estimation of either benefits or costs. For example, products with frequent, severe injuries do provide suitable targets for regulation when the injuries in question are amenable to reduction through regulation. But this reduction in injuries is precisely what is measured by benefit estimates, and there is at best limited argument for independent inclusions of accident frequency or severity as a determinant of policy, or for inclusion of other indirect criteria. One often alleged rationale for consideration of indirect factors (other than the political one of concealing the basis for policy decision) is that certain criteria are only with difficulty "evaluated in dollar terms." For example, project aspects which reduce extreme vulnerability of small children or promote severe industrial concentration indeed pose complex valuation problems. The flaw in this argument lies in the fact that any rational decision procedure must face the problem of tradeoffs between the basic benefit-cost results and additional criteria, and the actual tradeoffs that are necessarily made by way of decision reveal an implicit (possibly nonlinear) valuation of the additional criteria. Whether these tradeoffs are made in terms of dollars or "social welfare units" or "agency priority indices" can neither avoid nor obscure the problems of relative valuation, and the difficulties they cause for safety regulation.

Appendix

For a constant cost industry facing a consumer demand function which exhibits zero income elasticity of demand, social surplus is the difference between total value of the product and the sum of manufacturing and consumer risk costs:

$$SS = V(x) - [C(x) + R(x)]$$

$$V = \int_0^x p^*(y)dy$$

$C = ax$ — a is average manufacturing cost

$R = rx$ — r is per unit risk cost

Then the change in social surplus generated by CPSC regulation is:

$$\begin{aligned}\Delta SS &= \Delta V - \Delta C - \Delta R \\ &= \int_{x_0}^{x_1} p^*(y)dy - (a_1 x_1 - a_0 x_0) \\ &\qquad - (r_1 x_1 - r_0 x_0)\end{aligned}$$

Note that $p^* = a + r$ when the industry behaves perfectly competitively. Therefore:

$$\begin{aligned}\Delta SS &= \int_{x_0}^{x_1} p^*(y)dy - p_1\, x_1 + p_0\, x_0 \\ &= \int_{p_0^*}^{p_1^*} x^{-1}(z)dz\end{aligned}$$

where $x = x^{-1}(p^*)$, which monotonically decreases with p^*.

Table 1

CPSC Hazard Index, FY1976

Rank	Product[1]	AFSI[2]
1	Bicycles	35.7
2	Stairs	25.4
3	Football	13.8
4	Baseball	12.0
5	Playground Equipment	11.0
6	Tables (non-glass)	10.2
7	Swimming Pools	9.2
8	Beds	8.7
9	Fuels	8.4
10	Nails, etc.	7.6
11	Basketball	7.1
12	Chairs and Sofas	6.9
13	Household Cleaners	6.2
14	Architectural Glass	6.1
15	Floors	5.8
16	Ranges and Ovens	5.7
17	Lawnmowers	5.0
18	Skates and Skateboards	4.9
19	Furnaces	4.7
20	Bathtubs and Showers	4.5

[1] Abbreviated product description.

[2] Age adjusted frequency-severity index.

Table Two

CPSC Project Priorities; FY1977-1978

Rank	Project (Most Likely Strategy)
High Priority Projects	
1	Asbestos (MS)
2	Power Mowers (MS)
3	Gas Space Heaters (Ban)
4	Communication Antennae (MS)
5	Public Playground Equipment (MS)
6	Chlorofluorocarbons (IE)
7	Architectural Glass (MS)
8	Refuse Bins (Ban)
9	Lead-in-Paint (Ban)
10	Pacifiers (MS)
11	Toys--Generic Sharp Points (MS)
12	Methyl Alcohol (IE)
13	Upholstered Furniture (MS)
14	Toys--Generic Sharp Edges (MS)
15	Childrens' Sleepwear (Enforcement)
16	Miniature Christmas Tree Lights (MS)
17	Television Receivers (MS)
18	Aluminum Wire (MS)
19	Ranges and Ovens (VS)
20	Skateboards (MS)
21	Extension Cords and Trouble Lights (MS)
22	Bicycles (MS)
23	Bookmatches (MS)
24	Ladders (VS)
25	Energy Conservation Devices (Research)
26	Bathtubs and Showers (VS)
27	Smoke Detectors (Research)
28	Childrens' Football Helmets (MS)
29	Toys--Generic Small Parts (MS)
Medium Priority Projects	
1	Portable Power Saws (VS)
2	Chain Saws (VS)
3	OTC Antihistamines (Pack)
4	Power Drills (VS)
5	Petroleum Distallates (Pack)
6	Drain Cleaners (Ban)
7	Nonportable Power Saws (VS)
8	Eye Irritants (Research)
9	Wearing Apparel (MS)
10	Rust Removers (Ban)
11	Ammonia (IE)
12	Skin Irritants (Research)
13	Window Bars (VS)
14	Skiing Equipment (VS)
15	FHSA Flammability (Enforcement)
16	FFA Guarantees (Enforcement)
17	PPPA Exemptions (Enforcement)

Table Three

CPSC Project Priorities, FY1977-1978

Rank	Project	Strategy	Benefits	Costs	Hazard Index
High Priority Projects					
2	Power Lawnmowers	MS	112.5	285.0	5.62
3	Gas Spare Heaters	MS	5.8	3.0	.34
5	Public Playground Equipment	MS	10.5	5.2	4.88
7	Architectural Glass	MS	48.4	53.0	1.38
13	Upholstered Furniture	MS	412.3	855.0	1.77
17	Television Sets	MS	10.6	122.5	.60
19	Ranges and Ovens	VS	27.2	31.2	3.21
21	Extension Cords and Trouble Lights	MS	.8	7.6	.33
23	Bookmatches	MS	14.6	39.5	1.67
24	Ladders	VS	17.6	18.8	2.97
26	Bathtubs and Showers	VS	67.4	25.0	2.72
Medium Priority Projects					
1	Power Saws (Portable)	VS	2.4	5.0	3.25
2	Chain Saws	VS	6.8	10.2	.38
3	OTC Antihistamines	Pack	4.8	1.9	.60
5	Petroleum Disfollates	Pack	1.5	5.9	.22
6	Drain Cleaners	MS	1.1	1.0	.51
7	Power Saws (Non-Portable)	VS	.5	3.2	3.25
9	Wearing Apparel	MS	102.6	5000.0	1.45
10	Rust Removers	MS	.2	.5	.02
11	Ammonia	Pack	2.0	18.0	.14
Low Priority Project					
*	Aerosol Containers	VS	.8	70.5	.62
*	Electric Edge Trimmers	VS	3.5	9.0	.23
*	Gasoline Containers	VS	3.3	60.0	3.77
*	Soft Drink Containers	VS	3.8	65.0	.52
*	Tents	MS	.1	.5	.05

Table Four

Alternate Specifications of CPSC Preference Functions

Specification	Variable	Coefficient	C/SE Ratio
1	B	$.47 \times 10^{-2}$	1.86
	C	$-.34 \times 10^{-3}$	-1.47
	MS	1.31	2.65
		LR = 10.3	SPR = .840
2	BCR	.87	3.10
	MS	1.61	3.14
		LR = 14.4	SPR = .745
3	LNB	1.13	4.13
	LNC	-.83	-3.70
	MS	2.12	3.50
		LR = 28.1	SPR = .849
4	LNBCR	.76	3.32
	MS	1.76	3.37
		LR = 20.5	SPR = .801
5	RBC	1.27	3.67
	MS	2.16	3.56
		LR = 20.9	SPR = .785

B - Project Benefits to Consumers
C - Project Costs to Consumers
BCR - Ratio of B to C
LN* - Natural Logarithm of Variable *

Table Five

Alternate Specifications of CPSC Preference Functions

Specification	Variable	Coefficient	C/SE Ratio
1	LNB	1.10	3.85
	LNC	-.85	-3.72
	MS	2.22	3.29
	FI	.17	.34
		LR = 28.2	SPR = .875
2	LNB	1.14	4.14
	LNC	-.84	-3.72
	MS	1.99	2.95
	SI	.16	.40
		LR = 28.3	SPR = .840
3	LNB	1.12	4.01
	LNC	-.86	-3.63
	MS	2.34	3.16
	UNFOR	-.28	-.57
		LR = 28.5	SPR = .874
4	LNB	1.08	3.64
	LNC	-.84	-3.75
	MS	2.06	3.30
	PEXP	.17	.34
		LR = 28.2	SPR = .865
5	LNB	1.06	3.93
	LNC	-.81	-3.72
	MS	2.38	3.46
	VP	.33	.97
		LR = 29.1	SPR = .874

Table Six

Alternate Specifications of CPSC Preference Functions

Specification	Variable	Coefficient	C/SE Ratio
1	LNB	1.05	3.87
	LNC	-.83	-3.76
	MS	2.25	3.71
	HAZ	.34	1.73
		LR = 31.0	SPR = .859
2	LNB	1.00	3.46
	LNC	-.79	-3.38
	MS	2.31	3.74
	HAZ	.33	1.64
	VPC	.30	.51
		LR = 31.2	SPR = .851
3	LNB	1.24	3.95
	LNC	-.85	-3.64
	MS	2.39	3.82
	HAZ	.34	1.74
	VPE	-1.17	-1.41
		LR = 33.1	SPR = .846
4	LNB	1.03	3.66
	LNC	-.80	-3.32
	MS	2.29	3.69
	HAZ	.36	1.75
	DCR	-.43	-.37
		LR = 31.1	SPR = .832

Table Seven

Alternate Specifications of CPSC Preference Functions

Specification	Variable	Coefficient	C/SE Ratio
1	LNB	1.06	3.85
	LNC	-.82	-3.33
	MS	2.30	2.93
	HAZ	.35	1.72
	E77	-.005	-.10
		LR = 31.0	
2	LNB	1.04	3.80
	LNC	-.83	-3.69
	MS	2.36	3.43
	HAZ	.33	1.68
	PC78	.50	.33
		LR = 31.1	
3	LNB	1.09	3.46
	LNC	-.86	-3.33
	MS	2.31	3.44
	HAZ	.38	1.50
	AC	-.45	-.21
		LR = 31.0	

Table Eight

Alternate Specifications of CPSC Utility Functions

Specification	Variable	Coefficient	C/SE Ratio
1	RBC	.96	3.32
	MS	2.29	4.20
		LR = 23.0	SPR = .697
2	RBC	.93	3.05
	MS	2.07	3.35
	FI	-.18	-.32
		LR = 23.6	SPR = .645
3	RBC	1.14	3.53
	MS	2.43	3.57
	SI	-1.04	-1.59
		LR = 30.1	SPR = .701
4	RBC	.95	3.27
	MS	2.20	3.61
	E77	.007	.33
		LR = 23.1	SPR = .682
5	RBC	.86	2.84
	MS	2.46	4.21
	PC78	1.24	1.19
		LR = 24.5	SPR = .721

Table Nine

Actual Rank	Project	Predicted Rank
1	Power Lawnmowers	2
2	Gas Space Heaters	5
3	Public Playground Equipment	1
4	Architectural Glass	4
5	Upholstered Furniture	3
6	Television Sets	12
7	Ranges and Ovens	8
8	Extension Cords and Trouble Lights	11
9	Bookmatches	7
10	Ladders	9
11	Bathtubs and Showers	6
12	Power Saws (Portable)	13
13	Chain Saws	17
14	OTC Antihistamines	10
15	Petroleum Distallates	21
16	Drain Cleaners	16
17	Power Saws (Non-Portable)	19
18	Wearing Apparel	14
19	Rust Removers	22
20	Ammonia	23
23	Tents	15
23	Aerosol Containers	25
23	Gasoline Containers	20
23	Soft Drink Containers	24
23	Electric Edge Trimmers	18

Predicted rank for each project based on equation (1) of text and specification one of Table Six.

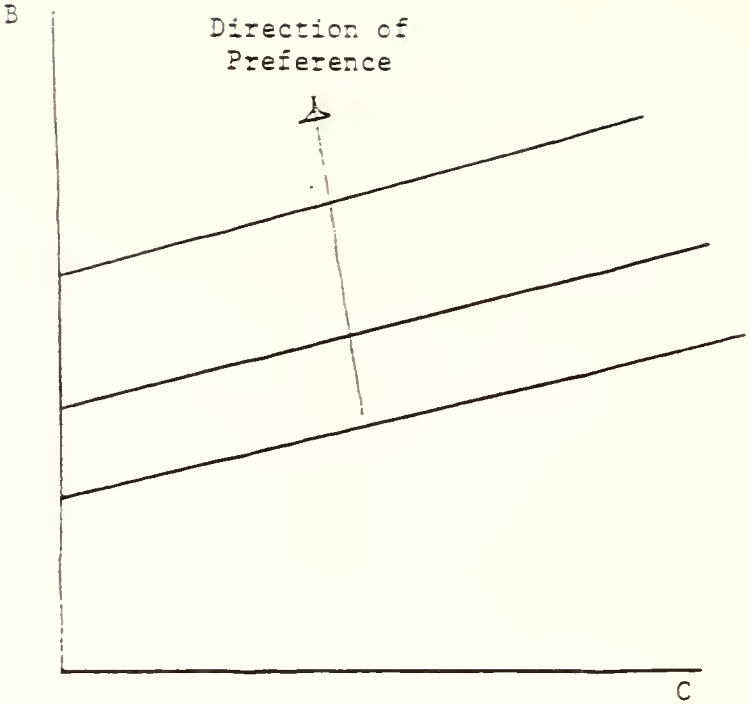

FIGURE
ONE

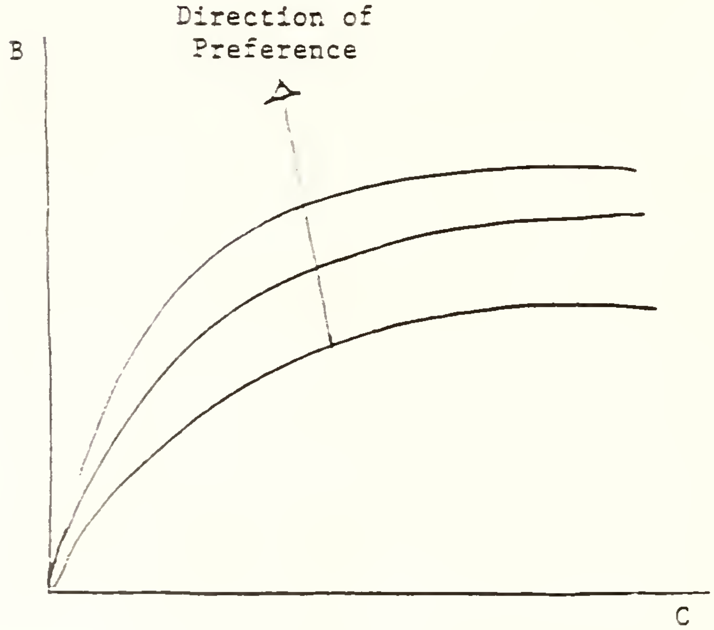

FIGURE
TWO

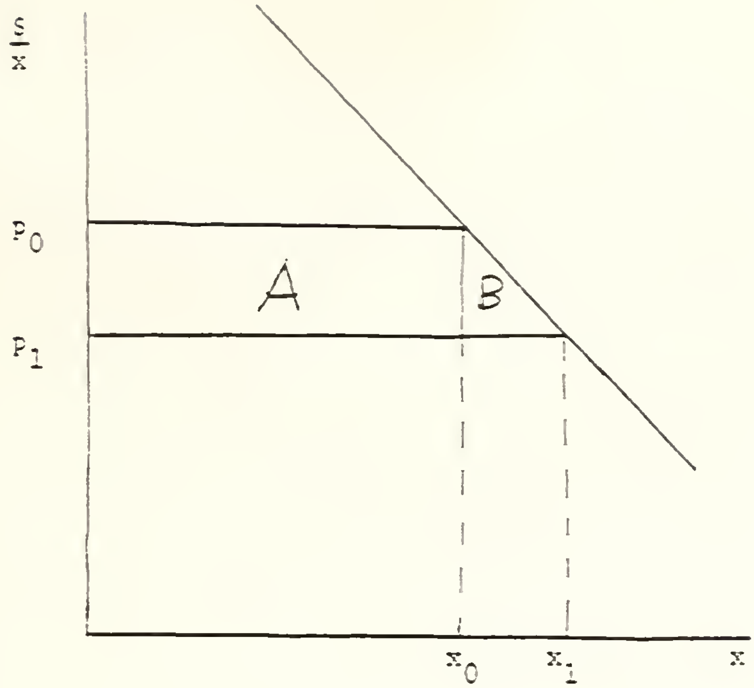

FIGURE THREE

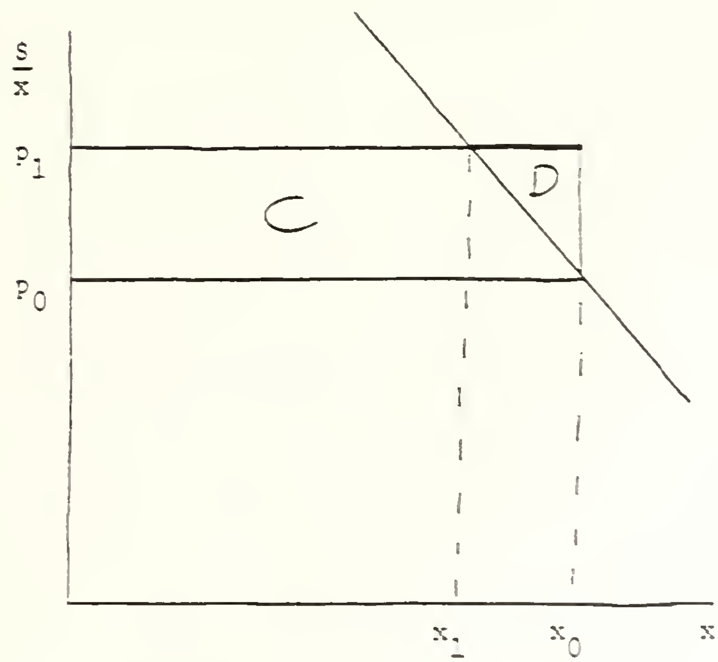

FIGURE FOUR

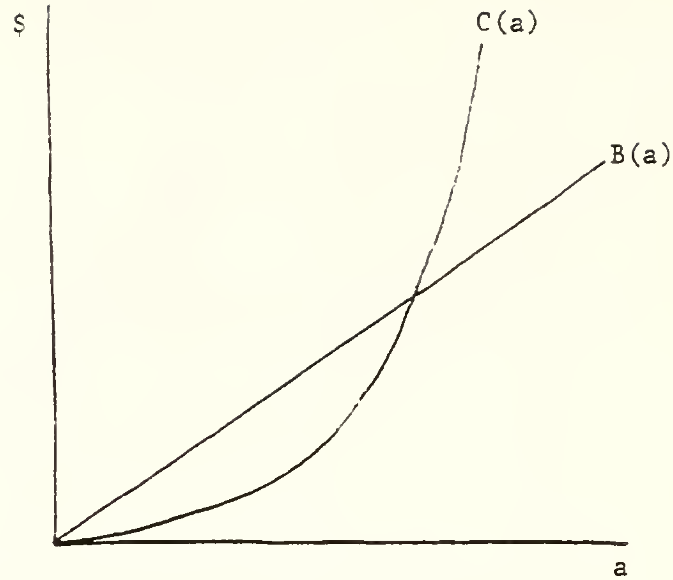

FIGURE FIVE

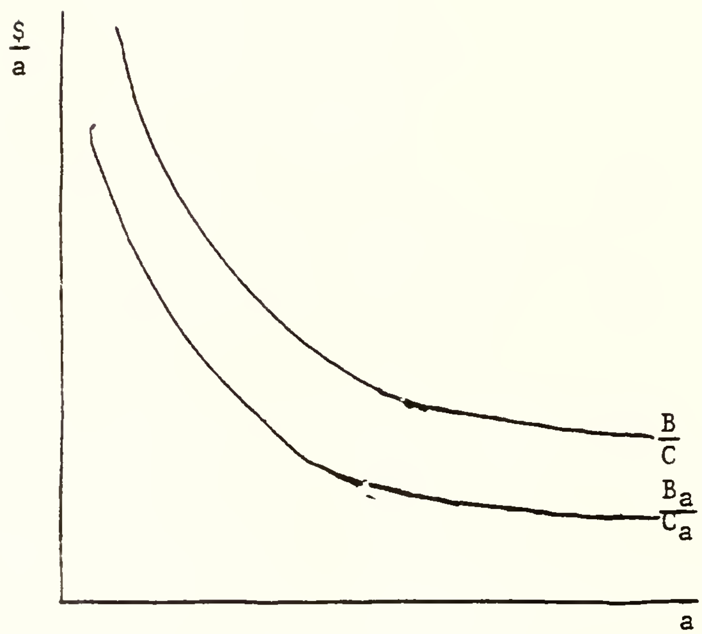

FIGURE SIX

Footnotes

[1]Research for this essay has been funded in part by the Brookings Institution. Thanks are due to Henry Grabowski, John Vernon, Dudley Wallace, and John Weymark for comments on an earlier version, and to Ellen Gritz for research assistance. Views expressed here are those of the author and should not be ascribed to any individual acknowledged above nor to the Brookings Institution.

[2]The Hazard Index consists of the sum for each product category over seven accident classes (based on severity of accident) of accident frequency times the associated class severity weight. Frequency is taken to be the number of accidents (in total and for each severity class) associated with the product in question, where the accident numbers are estimated and extrapolated from reports to hospital emergency rooms. Severity weights are drawn from an (easily questionable) numerical scale ranging from low weights for minor injuries to exponentially larger weights for consumer deaths. Adjustments are made to weight more heavily accidents occurring to children under 14 years of age. The resulting index numbers are understandably and technically known as the Age Adjusted Frequency-Severity Index.

[3]Kelman, Steve, "Regulation by the Numbers," The Public Interest, (Fall, 1974).

[4]Cornell, Nina, Roger Noll, and Barry Weingast, "Safety Regulation," in Setting National Priorities The Next Ten Years, Washington, D.C., Brookings, 1976.

[5]Thomas, L. G., "On Mechanisms for Promoting Public Participation in Regulation," mimeograph, 1978.

[6]For a more extensive discussion of these issues see L. G. Thomas, "Random Orderings and the Random Utility Model with Independently, Identically Distributed Errors," mimeograph, 1979.

[7]This linear combination may be regarded as an approximation to more complex functional forms. The utility function U_j is technically the indirect utility function as agency resource constraints should be factored into agency decisions.

[8]McFadden, Daniel, "Quantal Choice Analysis: A Survey," Annals of Economic and Social Measurement, (Fall, 1976).

[9]The original project numbering provides a sequence of projects denoted x_j; the agency ranking provides a renumbering of projects into a new sequence, denoted w_k.

[10]For the derivation of this result, see the reference in footnote 6.

[11]This result was first demonstrated by Daniel McFadden, "Conditional Logit Analysis of Quantitative Choice Behavior," in Paul Zarembka, ed. Frontiers in Econometrics, Academic Press, New York, 1973.

[12]This equation was first derived, in a quite different context, by H. D. Block and Jacob Marschak, "Random Orderings and Stochastic Theories of Response," in I. Olkin, ed. Contributions to Probability and Statistics, Stanford University Press, 1960.

[13]The value of the likelihood function when evaluated at the zero vector is -53.22.

[14]Values of the relevant statistic with 1 and (315 - p) degrees of freedom where (p) is the number of coefficients estimated are for specifications one of Table Four, three of Table Four, and one of Table Six respectively, 3.13, 7.67, and 4.05.

[15]The correlations between the various rating variables and either LNB, LNC, or MS are all uniformly low.

[16]Significance of the Hazard Index alongside insignificance of the FI and Si variables appears to occur because the Index isolates a handful of projects with very high Index values, while both the staff prepared rating variables exhibit far less variance among projects.

[17]The division by $d(1-d)^{-1}$ is acceptable procedure as a) the benefit-cost ratio is unchanged, and b) the division applies uniformly to costs and benefits of all projects, hence will not affect utility rankings given the linear and logarithmic specification of utility functions used in this essay.

[18]To the extent that consumers fail to perceive product risk prior to purchase, changes in market price rather than full price determine quantity demanded.

[19]These arguments parallel those of Peter Steiner on more general budgeting issues, in Alan Blinder and Robert Solow, The Economics of Public Finance (Brooking, 1974).

[20]In a strict technical sense, the priority decision is an application of integer programming known as the "knapsack problem." The argument of the text is an approximation to the solution of the knapsack problem due to the implicit assumption that agency resource constraints are not completely strict. The notion is that should the last project selected not be fully fundable in the given fiscal year, it may be completed in the next year.

[21]The equation in the text represents a necessary condition for maximization of $U(B(a), C(a))$, where $MRS_{CB} = \frac{-U_C}{U_B}$.